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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/296,835	04/22/1999	RONALD A. WEIMER	M4065.0319/P319	8895

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EXAMINER	
KIELIN, ERIK J.	

ART UNIT	PAPER NUMBER
2813	

DATE MAILED: 12/13/2001

Please find below and/or attached an Office communication concerning this application or proceeding.

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Office Action Summary

Application No.	Applicant(s)
09/296,835	Weimer et al.
Examiner	**Art Unit**
Erik Kielin	2813

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136 (a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1) ☒ Responsive to communication(s) filed on *Nov 27, 2001* .

2a) ☒ This action is **FINAL.** 2b) ☐ This action is non-final.

3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11; 453 O.G. 213.

Disposition of Claims

4) ☒ Claim(s) *2-6, 8, and 10-12* is/are pending in the application.

4a) Of the above, claim(s) _____ is/are withdrawn from consideration.

5) ☐ Claim(s) _____ is/are allowed.

6) ☒ Claim(s) *2-6, 8, and 10-12* is/are rejected.

7) ☐ Claim(s) _____ is/are objected to.

8) ☐ Claims _____ are subject to restriction and/or election requirement.

Application Papers

9) ☐ The specification is objected to by the Examiner.

10) ☐ The drawing(s) filed on _____ is/are objected to by the Examiner.

11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved.

12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. § 119

13) ☐ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d).

a) ☐ All b) ☐ Some* c) ☐ None of:

1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

*See the attached detailed Office action for a list of the certified copies not received.

14) ☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

Attachment(s)

15) ☐ Notice of References Cited (PTO-892)
16) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
17) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s). _____
18) ☐ Interview Summary (PTO-413) Paper No(s). _____
19) ☐ Notice of Informal Patent Application (PTO-152)
20) ☐ Other:

DETAILED ACTION

Claim Rejections - 35 USC § 112

1. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

2. Claims 8, 2-6, 10-12 are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

Applicant's specification does not provide support for "a wet oxidation with a mixture of hydrogen and oxygen gases." Instead, the specification makes clear that the water vapor or steam for the wet oxidation results from a reaction between the hydrogen and oxygen to form the water vapor. (See page 8.) Given the ratio of hydrogen to oxygen, there is no excess hydrogen in the reactor because it is well known in the art that hydrogen would cause a reduction (i.e. a loss of oxygen) --not an oxidation-- of the ferroelectric, thereby damaging the ferroelectric layer, contrary to the teaching of the specification.

For the purposes of patentability, it will be assumed that Applicant intends the claim to indicate "a wet oxidation wherein a mixture of hydrogen and oxygen gases is used to form the

water vapor or steam" to be consistent with the specification at page 8 and claims 5 and 6 as originally filed.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims **8**, 2-6 10-12 are rejected under 35 U.S.C. 102(b) as being anticipated by **Patel** et al. (US 5,374,578) in view of in view of the excerpt from **Van Zant**, (Microchip Fabrication, A Practical Guide to Semiconductor Processing, 3rd ed. McGraw-Hill: New York, 1997, pp. 157-160) and either of **Emesh** et al. (US 5,728,603) and **Chivukula** et al. (US 6,066,581).

Patel discloses forming an oxygen deficient ferroelectric film 14 (Figs. 2-6) such as PZT which inherently has a dielectric constant of greater than 25; annealing the ferroelectric film in "[g]ases like oxygen, ozone or air" (column 4, lines 10-11) using RTA (which must necessarily occur, then, in an RTA chamber) at a temperature range of 650-850°C for about 5-30 seconds (in one example) in order to increase the oxygen content of the ferroelectric film (column 2, lines 30-

33); performing a stabilizing treatment using oxygen either before or after the ozone anneal (column 4, lines 23-29).

Patel does not teach using wet oxidation using a mixture of hydrogen and oxygen to form the steam.

Emesh teaches forming an oxygen deficient ferroelectric material such as PZT; subjecting the dielectric film to a wet oxidation using a mixture comprising water and ozone in a rapid thermal annealing (RTA) chamber in order to reduce the temperature at which the ferroelectric material densifies/crystallizes and also to reduce the stress in the ferroelectric film and improves its the electrical properties (column 5, lines 50-67) which also inherently increases the oxygen content of the film as indicated by reduced leakage current (sentence bridging columns 3-4).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to incorporate water during the ozone anneal of **Patel** for the reasons indicated in **Emesh** which includes at least to reducing the stress in the ferroelectric film and improving its the electrical properties (column 5, lines 50-67).

Regarding the dielectric constant of various ferroelectric materials, see **Emesh**, column 8, Table I.

Similarly, **Chivukula** teaches forming an oxygen deficient ferroelectric material such as PZT; subjecting the dielectric film to a wet oxidation using a mixture comprising water and ozone at a temperature of 450-650°C in a rapid thermal annealing (RTA) chamber for 30 seconds to several minutes to form uniform grain sizes in the ferroelectric material in a shorter time, at

reduced temperature and superior characteristics during high frequency use compared to using dry oxidation (column 14, lines 27-48). (See also column 13, lines 30-53.)

It would have been obvious to one of ordinary skill in the art at the time the invention was made to incorporate water during the ozone anneal of **Patel** for the reasons indicated in **Chivukula**, as noted.

Then the only difference is that using a mixture of hydrogen and oxygen to form the wet oxidation gas mixture is not taught, instead **Emesh** and **Chivukula** teach using a bubbler.

Van Zant teaches that "Dryox," a mixture of hydrogen and oxygen which react to form a steam oxidizing mixture in the reactor is preferred over liquid systems such as a bubbler because the process is cleaner and more controllable and also that "Dryox is the preferred method for production of advanced devices." (See pp. 157-160 -- especially page 160.) It would have been obvious to one of ordinary skill in the art at the time the invention was made to use hydrogen and oxygen to form the wet oxidation mixture for the reasons indicated in **Van Zant**, as noted.

Furthermore, it would be a matter of design choice as to which method of introducing the water to the oxidizing atmosphere of Patel because any known method would work just as well and because there is no evidence of record to indicate that the mixture of hydrogen and oxygen would work better. Rather, Applicant's specification teaches away from such unexpected results. Applicant teaches

> "One of several techniques can be used to provide steam to a vicinity of the insulating film. Such techniques include using a **bubbled water vapor system**, a

pyrogenic system or a catalytic system, or generating steam in the chamber *in situ*."

(Emphasis added. See instant specification, page 3, lines 13-17.)

In other words, any of the presently notoriously well known ways to form the steam, which are specifically used in the art for oxidation, could be used, according to Applicant. Also note that the paragraph bridging pages 7 and 8 of Applicant's specification indicates specifically that a bubbler can be used in the instant invention.

Regarding claims 2-4, although **Patel** does not recite Applicant's exact ranges of either 450-750°C or 750-900°C or exact times of 20-60 seconds for the oxidation, **Patel** does disclose an overlapping temperature range of 650-850 and time range of 5-30 seconds, in at least one example. **Emesh** teaches 300 seconds which is a function of the lower temperatures used. **Chivukula** teaches 30 seconds to several minutes which is again temperature and material dependent. These claims are *prima facie* obvious without showing that the claimed ranges achieve unexpected results relative to the prior art range. *In re Woodruff*, 16 USPQ2d 1935, 1937 (Fed. Cir. 1990). See also *In re Aller*, 105 USPQ 233 (CCPA 1955) (selection of optimum ranges within prior art general conditions is obvious). It would have been obvious to one of ordinary skill in the art at the time the invention was made to optimize the temperature and anneal time to provide the best ferroelectric film, according to the precedent above. Also note, although **Emesh** teaches an ozone/water oxidizing temperature of 500°C or less, Emesh also teaches that increasing the temperature at which the wet oxidation occurs increases the dielectric constant of

the high dielectric constant film (column 8, lines 6-12) which is desired in the semiconductor device fabrication art especially for fabricating capacitors for DRAM devices.

Then, regarding claims 5 and 6, the only difference is that the claimed ratios of hydrogen to oxygen gases is not taught. It has been held that selection of optimum ranges within prior art general conditions is *prima facie* obvious in the absence of unexpected results. It would have been obvious to one of ordinary skill in the art at the time the invention was made to optimize the hydrogen to oxygen gases to perform the taught wet oxidation process for forming the best ferroelectric film, according to precedent, *supra*.

Regarding claim 11, **Patel** does not teach performing the ozone oxidizing or the oxygen stabilizing treatments at different temperatures, each of **Emesh** and **Chivukula** teaches that the addition of water vapor reduces the densification/crystallization temperature from dry conditions. It would have been obvious to one of ordinary skill in the art at the time the invention was made to perform the wet ozone anneal of **Patel** at a lower temperature than the oxygen stabilizing anneal because each of **Emesh** and **Chivukula** teaches a lower temperature may be used for wet versus dry oxidation.

Response to Arguments

5. Applicant's arguments filed 11/27/01 have been fully considered but they are not persuasive.

Applicant argues that Patel would not be properly combined with either of Chivukula and Emesh because Patel, allegedly teaches away from the use of oxygen. Examiner respectfully but

expressly disagrees because of the express teaching of Patel. Patel expressly indicates that oxygen, ozone, or **air** may be used to anneal the ferroelectric (column 4, lines 10-11). Patel further discloses express examples wherein **oxygen alone** or oxygen-ozone combination anneals are used (column 4, lines 23-35). To allege that Patel teaches away from the use of oxygen simply because ozone is "preferred" is simply and absolutely false based upon the express teachings of Patel. For at least this reason, Applicant's argument is not considered to have merit and is not persuasive in the least.

Conclusion

6. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication from examiner should be directed to Erik Kielin whose telephone number is (703) 306-5980 and e-mail address is erik.kielin@uspto.gov. The examiner can normally be reached by telephone on Monday through Thursday 9:00 AM until 7:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Charles Bowers, can be reached at (703) 308-2417 or by e-mail at charles.bowers@uspto.gov. The fax phone number for the group is (703) 308-7722 or -7724.

EK

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December 10, 2001

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